Announcements

- Homework for tomorrow…

  Ch. 29: CQ 10, Probs. 20, 22, & 54

  CQ4a) $E_1 = E_2 = -(10\ \mathrm{V/m})$ ihat b) $E_1 = -(5\ \mathrm{V/m})$ ihat, $E_2 = -(20\ \mathrm{V/m})$ ihat

  CQ5: accelerates right

  29.6: W = 1.6×10^{-13} J

  29.12: $E_x(0\mathrm{cm}<x<2\mathrm{cm}) = +2{,}500\ \mathrm{V/m}$ $E_x(2\mathrm{cm}<x<3\mathrm{cm}) = -10{,}000\ \mathrm{V/m}$

  29.44: $E = 40\ \mathrm{V/m}$, $\theta = 27°$ ccw from $+x$-axis

- Office hours…

  MW 10-11 am

  TR 9-10 am

  F 12-1 pm

- Tutorial Learning Center (TLC) hours:

  MTWR 8-6 pm

  F 8-11 am, 2-5 pm

  Su 1-5 pm

Chapter 29

Potential & Field

(*Combinations of Capacitors*)

Review…

- *Kirchoff's Loop Rule…*

$$\boxed{\Delta V_{loop} = \sum_i (\Delta V)_i = 0}$$

- *Conductors in Electrostatic Equilibrium…*

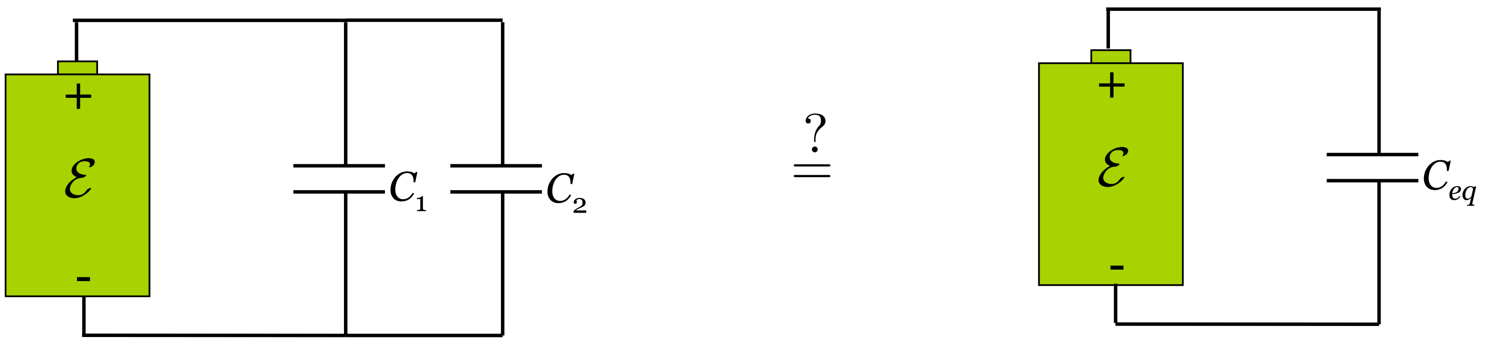
- *Capacitance…*

$$\boxed{C \equiv \frac{Q}{\Delta V_C}} \qquad C = \frac{\epsilon_0 A}{d} \quad \text{(parallel-plate capacitor)}$$

Combinations of Capacitors

Consider two capacitors in *parallel*…

- Can we find an *equivalent capacitor*, C_{eq}, to the two capacitors, C_1 & C_2?



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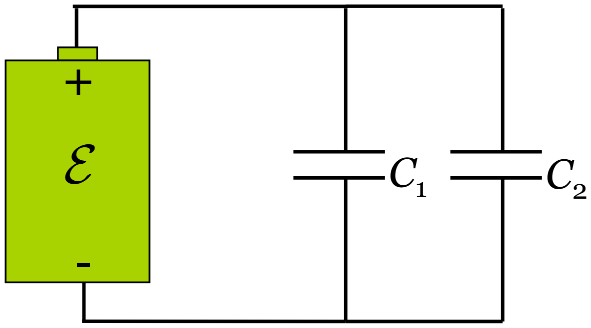
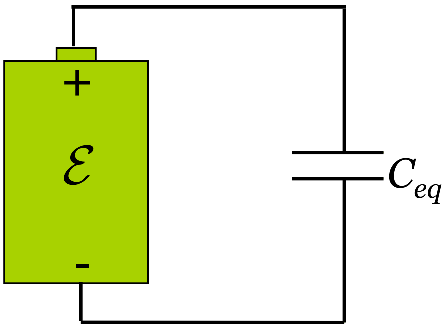


$\stackrel{?}{=}$



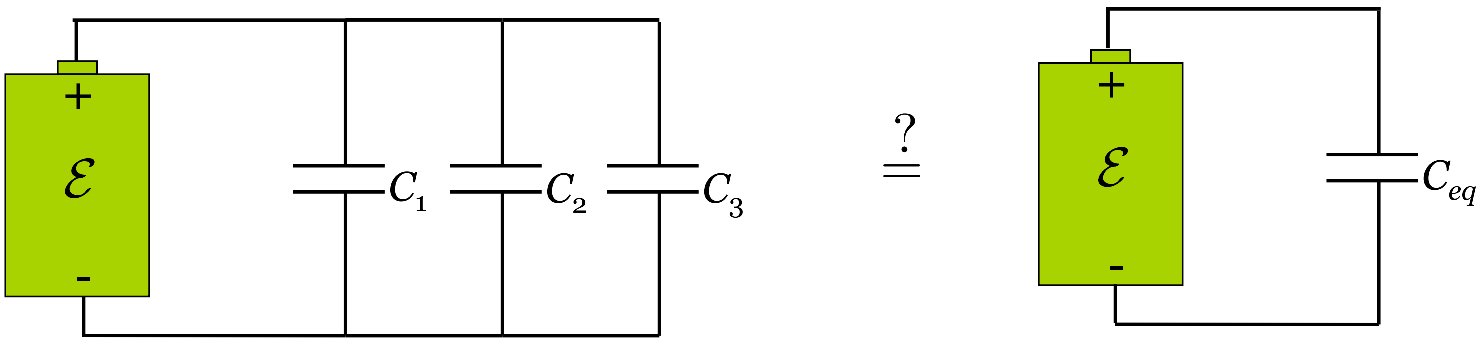
- YES!

$$C_{eq} = C_1 + C_2$$

Combinations of Capacitors

What about for *several* capacitors in *parallel*?

- Can we find an *equivalent capacitor*, C_{eq}, to the capacitors, C_1, C_2, … *(all in parallel)*?



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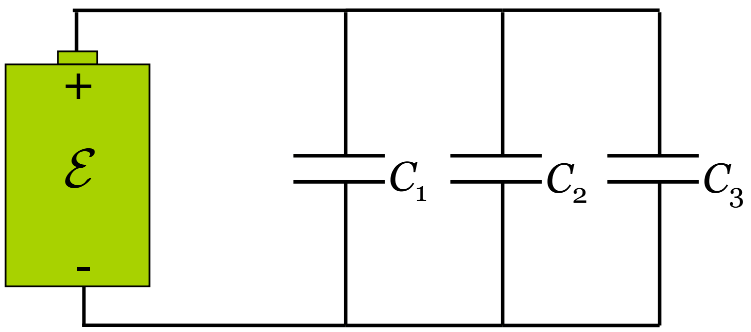

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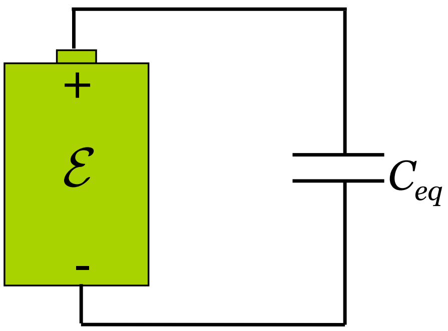

$$C_{eq} = C_1 + C_2 + \ldots$$

Combinations of Capacitors

Consider two capacitors in *series*…

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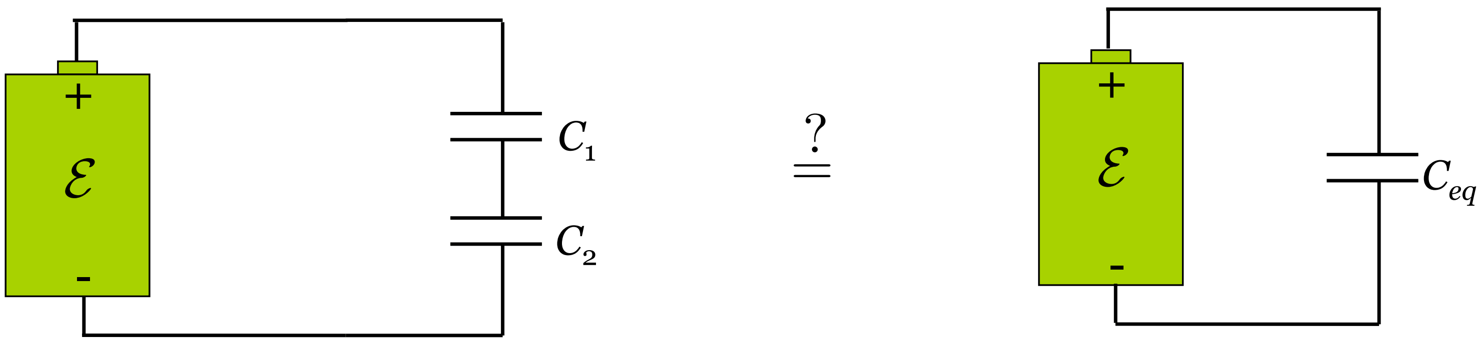

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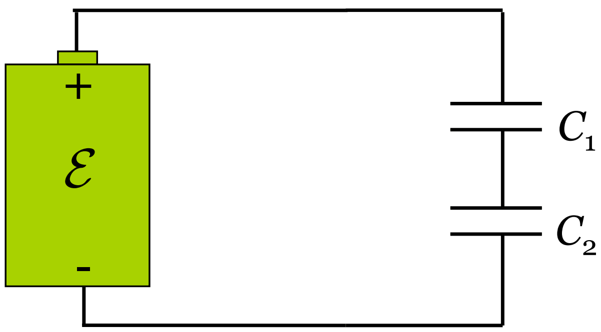

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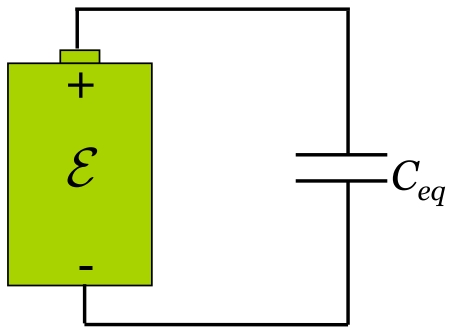

- YES!

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

Combinations of Capacitors

What about several capacitors in *series*?

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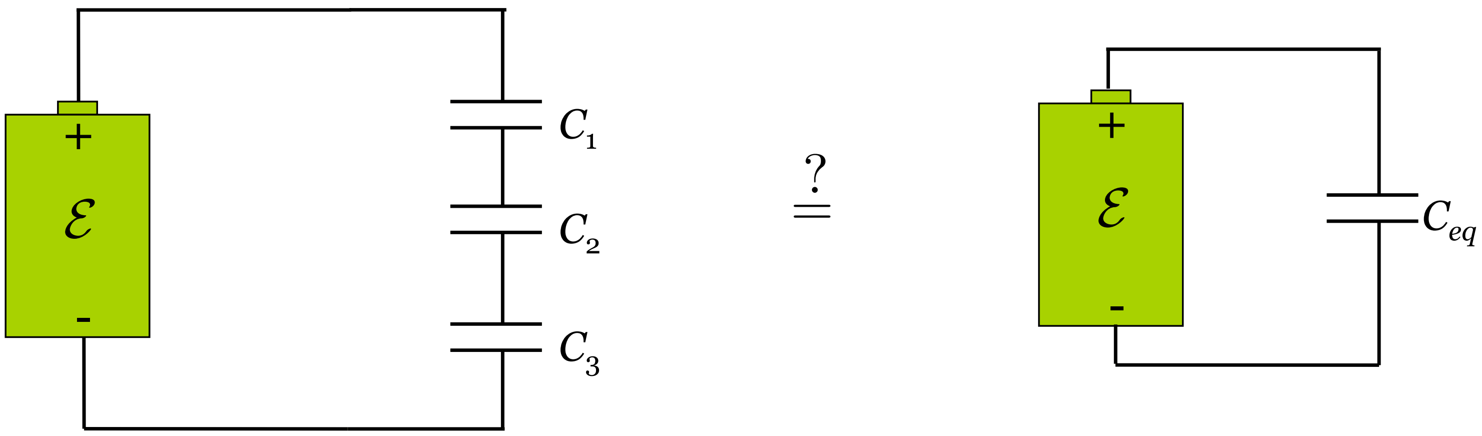

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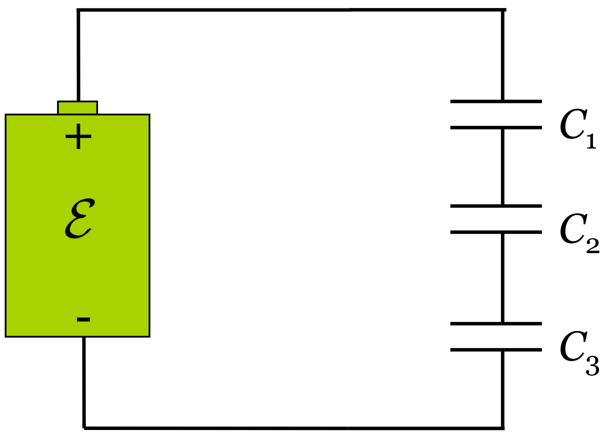

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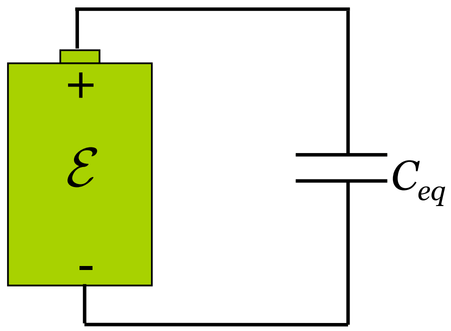
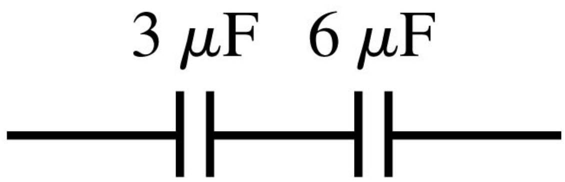


$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$$

Quiz Question 1

The equivalent capacitance is

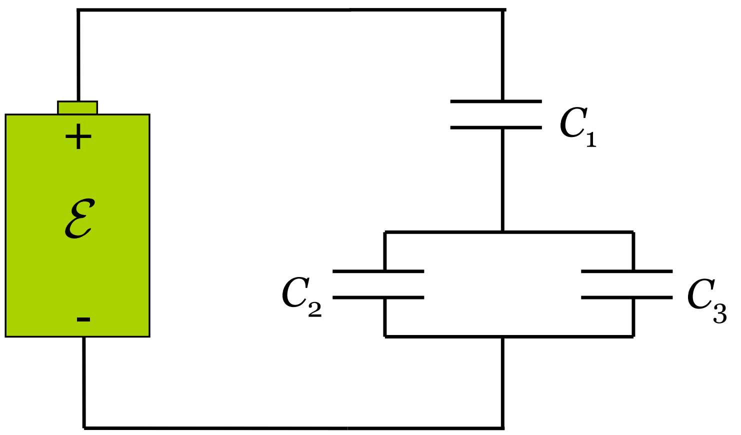


1. 9 μF.
2. 6 μF.
3. 3 μF.
4. 2 μF.
5. 1/2 μF.

i.e. 29.7:
A Capacitor Circuit

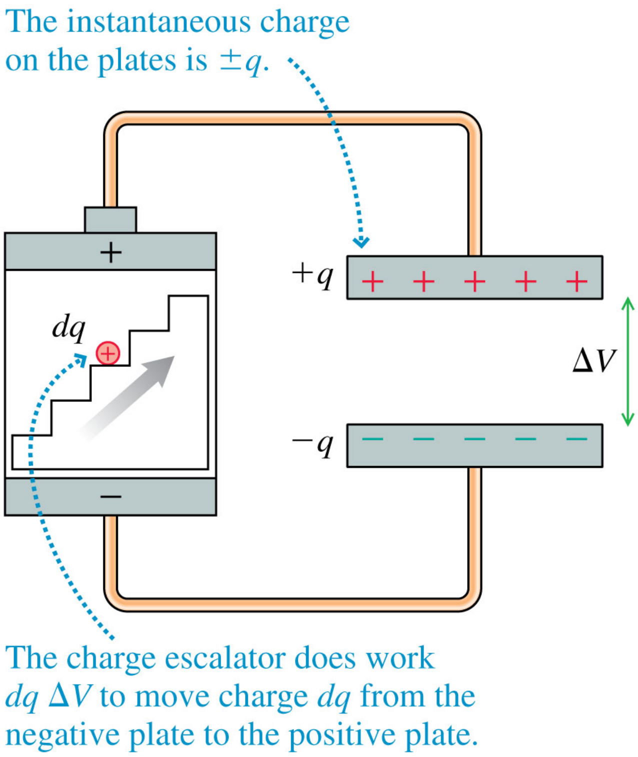
Find the charge on and the potential difference across each of the three capacitors in the figure below.

Given: $\mathcal{E}$ = 12 V, C_1 = 3 μF, C_2 = 5 μF , C_3 = 1 μF



29.6: The Energy Stored in a Capacitor

How much *energy* is transferred from the battery to the capacitor?



$$\text{Initially}: \ q = 0, \ U = 0$$

$$\text{Finally}: \ q = Q, \ U = U_C$$

29.6: The Energy Stored in a Capacitor

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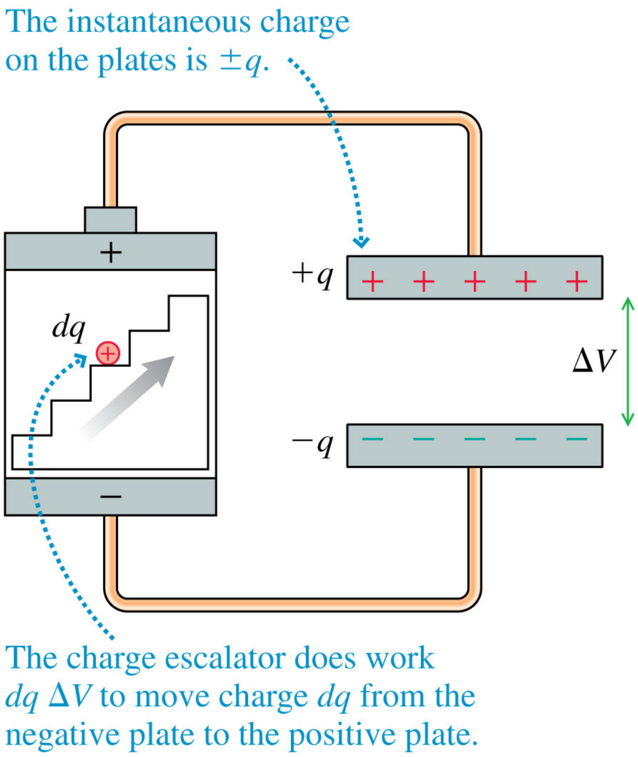


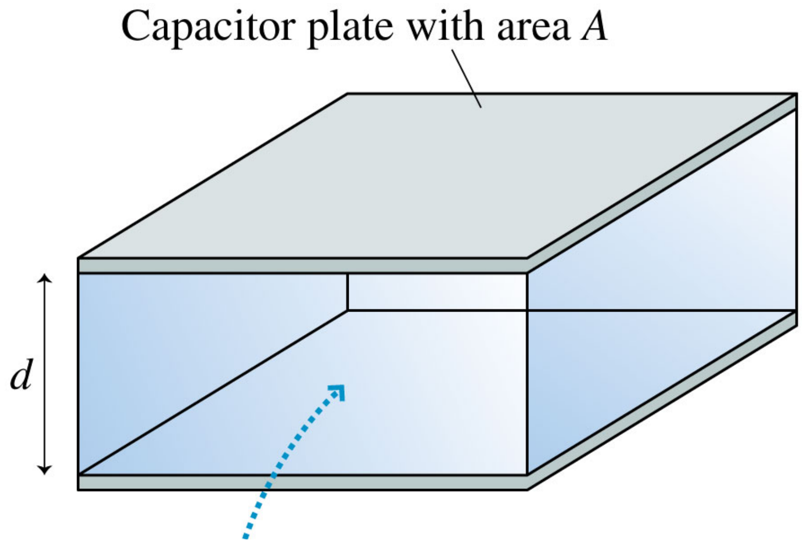
$$U_C = \frac{Q^2}{2C}$$

or

$$U_C = \frac{1}{2}C(\Delta V_C)^2$$

The Energy in the Electric Field

Q: If a capacitor is analogous to a stretched spring, *where* is the stored energy?



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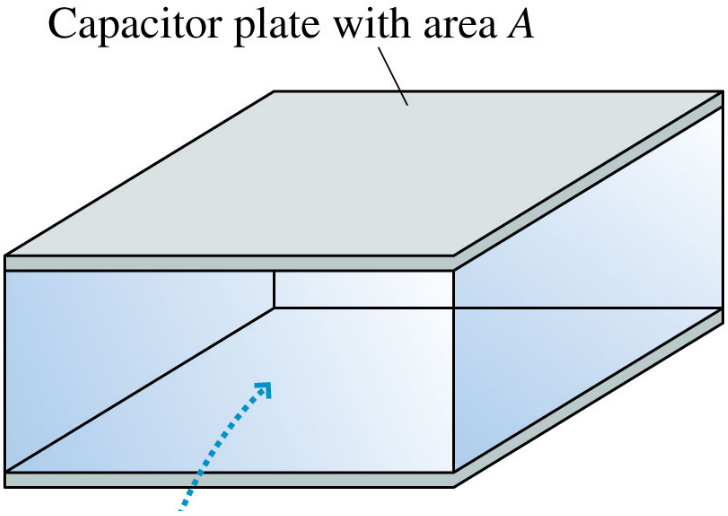

- A: In the E-field!

$$\boxed{u_E = \frac{1}{2}\epsilon_0 E^2}$$

$$u_E = \frac{\text{energy stored}}{\text{volume in which it is stored}}$$

When the capacitor is discharged, the energy is released as the E-field *collapses*.